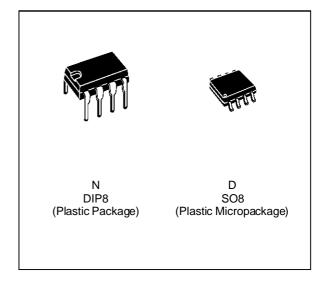


### TL081 TL081A - TL081B

# GENERAL PURPOSE SINGLE J-FET OPERATIONAL AMPLIFIERS

- LOW POWER CONSUMPTION
- WIDE COMMON-MODE (UP TO V<sub>CC</sub><sup>+</sup>) AND DIFFERENTIAL VOLTAGE RANGE
- LOW INPUT BIAS AND OFFSET CURRENT
- OUTPUT SHORT-CIRCUIT PROTECTION
- HIGH INPUT IMPEDANCE J-FET INPUT STAGE
- INTERNAL FREQUENCY COMPENSATION
- LATCH UP FREE OPERATION
- HIGH SLEW RATE: 16V/µs (typ)



#### **DESCRIPTION**

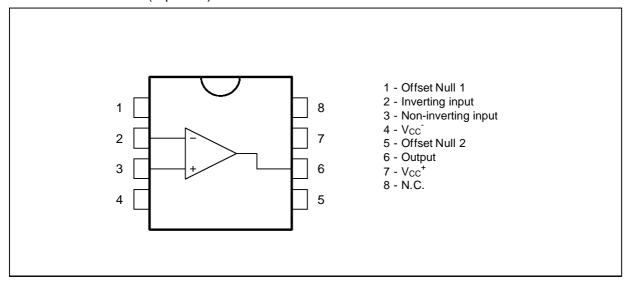
The TL081, TL081A and TL081B are high speed J–FET inputsingle operational amplifiers incorporating well matched, high voltage J–FET and bipolar transistors in a monolithic integrated circuit.

The devices feature high slew rates, low input bias and offset currents, and low offset voltage temperature coefficient.

#### **ORDER CODES**

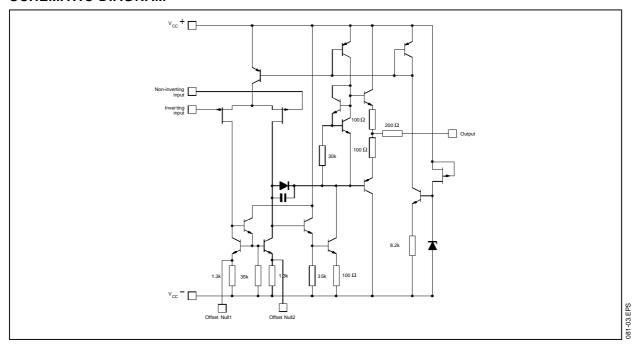
Part Number	Temperature	Package				
Part Number	Range	N	D	1		
TL081M/AM/BM	−55°C, +125°C	•	•			
TL081I/AI/BI	−40°C, +105°C	•	•			
TL081C/AC/BC	0°C, +70°C	•	•	1.TBL		
Examples : TL081CD, TL081IN						

### PIN CONNECTIONS (top view)

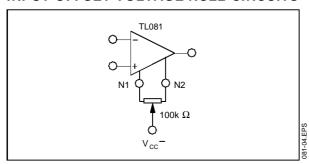


November 1995

### **SCHEMATIC DIAGRAM**



### INPUT OFFSET VOLTAGE NULL CIRCUITS



### **ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
Vcc	Supply Voltage - (note 1)	±18	V
Vi	Input Voltage - (note 3)	±15	V
$V_{id}$	Differential Input Voltage - (note 2)	±30	V
P <sub>tot</sub>	Power Dissipation	680	mW
	Output Short-circuit Duration - (note 4)	Infinite	
T <sub>oper</sub>	Operating Free Air Temperature Range TL081C,AC TL081I,AI, TL081M,AI	BÍ –40 to 105	°C
T <sub>stg</sub>	Storage Temperature Range	-65 to 150	°C

Notes:

- All voltage values, except differential voltage, are with respect to the zero reference level (ground) of the supply voltages where the zero reference level is the midpoint between V<sub>CC</sub><sup>+</sup> and V<sub>CC</sub>...
   Differential voltages are at the non-inverting input terminal with respect to the inverting input terminal.
   The magnitude of the input voltage must never exceed the magnitude of the supply voltage or 15 volts, whichever is less.
   The output may be shorted to ground or to either supply. Temperature and /or supply voltages must be limited to ensure that the dissipation rating is not exceeded.



### **ELECTRICAL CHARACTERISTICS**

 $V_{CC}$  = ±15V,  $T_{amb}$  = 25 $^{o}$ C (unless otherwise specified)

Symbol	Parameter	TL081I,M,AC,AI, AM,BC,BI,BM			TL081C			Unit
•		Min.	Тур.	Max.	Min.	Тур.	Max.	
Vio	$ \begin{array}{l} \text{Input Offset Voltage } (R_S = 50\Omega) \\ T_{amb} = 25^{\circ}C \\ T_{min.} \leq T_{amb} \leq T_{max.} \\ \end{array} $ $ TL081BC,BI,BM \\ TL081BC,BI,BM \\ \end{array} $		3 1	6 3 7 5		3	10 13	mV
DV <sub>io</sub>	Input Offset Voltage Drift		10			10		μV/°C
l <sub>io</sub>	Input Offset Current * $T_{amb} = 25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		5	100 4		5	100 4	pA nA
l <sub>ib</sub>	Input Bias Current * $T_{amb} = 25^{\circ}C$ $T_{min.} \le T_{amb} \le T_{max.}$		20	200 20		20	400 20	pA nA
$A_{vd}$	$ \begin{array}{l} \text{Large Signal Voltage Gain (R}_L = 2k\Omega, \ V_O = \pm 10\text{V)} \\ T_{amb} = 25^{\circ}\text{C} \\ T_{min.} \leq T_{amb} \leq T_{max.} \end{array} $	50 25	200		25 15	200		V/mV
SVR	Supply Voltage Rejection Ratio ( $R_S = 50\Omega$ ) $T_{amb} = 25^{\circ}C$ $T_{min.} \le T_{amb} \le T_{max.}$	80 80	86		70 70	86		dB
Icc	Supply Current, no Load $ T_{amb} = 25^{\circ}C \\ T_{min.} \le T_{amb} \le T_{max.} $		1.4	2.5 2.5		1.4	2.5 2.5	mA
V <sub>icm</sub>	Input Common Mode Voltage Range		+15 -12		±11	+15 -12		V
CMR	Common Mode Rejection Ratio (R <sub>S</sub> = $50\Omega$ ) $T_{amb} = 25^{\circ}C$ $T_{min.} \le T_{amb} \le T_{max.}$	80 80	86		70 70	86		dB
los	Output Short-circuit Current $T_{amb} = 25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$	10 10	40	60 60	10 10	40	60 60	mA
±V <sub>OPP</sub>	$ \begin{array}{ll} \text{Output Voltage Swing} \\ T_{amb} = 25^{\circ}\text{C} & R_{L} = 2k\Omega \\ R_{L} = 10k\Omega \\ T_{min.} \leq T_{amb} \leq T_{max.} & R_{L} = 2k\Omega \\ R_{L} = 10k\Omega \\ \end{array} $	10 12 10 12	12 13.5		10 12 10 12	12 13.5		V
SR	Slew Rate ( $V_{in}$ = 10V, $R_L$ = 2k $\Omega$ , $C_L$ = 100pF, $T_{amb}$ = 25°C, unity gain)	8	16		8	16		V/µs
t <sub>r</sub>	Rise Time ( $V_{in}$ = 20mV, $R_L$ = 2k $\Omega$ , $C_L$ = 100pF, $T_{amb}$ = 25°C, unity gain)		0.1			0.1		μs
Kov	Overshoot ( $V_{in}$ = 20mV, $R_L$ = 2k $\Omega$ , $C_L$ = 100pF, $T_{amb}$ = 25°C, unity gain)		10			10		%
GBP	Gain Bandwidth Product (f = 100kHz, $T_{amb}$ = 25°C, $V_{in}$ = 10mV, $R_L$ = 2k $\Omega$ , $C_L$ = 100pF)	2.5	4		2.5	4		MHz
Ri	Input Resistance		10 <sup>12</sup>			10 <sup>12</sup>		Ω
THD	Total Harmonic Distortion (f = 1kHz, $A_V$ = 20dB, $R_L$ = 2k $\Omega$ , $C_L$ = 100pF, $T_{amb}$ = 25°C, $V_O$ = 2V <sub>PP</sub> )		0.01			0.01		%
en	Equivalent Input Noise Voltage (f = 1kHz, $R_s = 100\Omega$ )		15			15		$\frac{\text{nV}}{\sqrt{\text{Hz}}}$
Øm	Phase Margin		45			45		Degrees

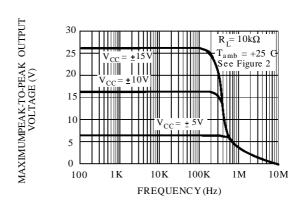
<sup>\*</sup> The input bias currents are junction leakage currents which approximately double for every 10°C increase in the junction temperature.



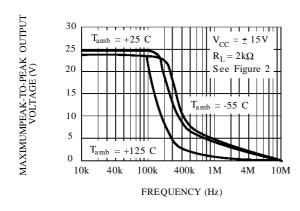
### MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE VERSUS FREQUENCY

#### 30 V<sub>CC</sub> = ± 15V $R_L = 2k\Omega$ MAXIMUM PEAK-TO-PEAKOUTPUT 25 $T_{amb} = +25^{\circ}C$ See Figure 2 20 VOLTAGE(V) ± 10V 15 10 = ± 5V 5 0 100 1K 1M 10M FREQUENCY (Hz)

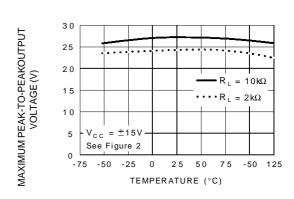
## MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE VERSUS FREQUENCY



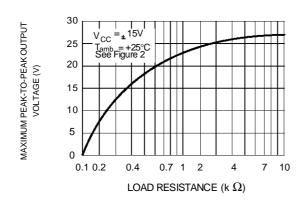
### MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE VERSUS FREQUENCY



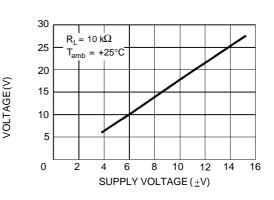
MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE VERSUS FREE AIR TEMP.



## MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE VERSUS LOAD RESISTANCE



# MAXIMUM PEAK-TO-PEAK OUTPUT VOLTAGE VERSUS SUPPLY VOLTAGE

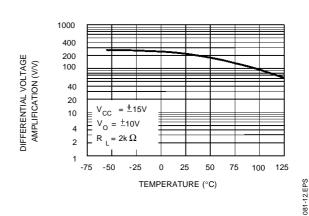


MAXIMUM PEAK-TO-PEAKOUTPUT

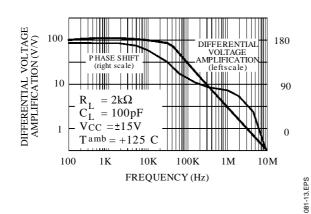
### INPUT BIAS CURRENT VERSUS FREE AIR TEMPERATURE

# 100 V<sub>CC</sub> = ± 15V 10 0.01 -50 -25 0 25 50 75 100 125 TEMPERATURE (°C)

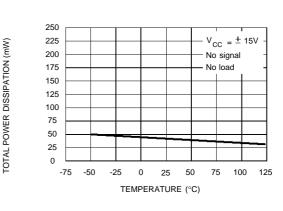
# LARGE SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION VERSUS FREE AIR TEMPERATURE



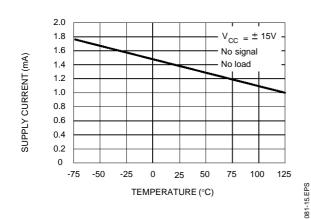
# LARGE SIGNAL DIFFERENTIAL VOLTAGE AMPLIFICATION AND PHASE SHIFT VERSUS FREQUENCY



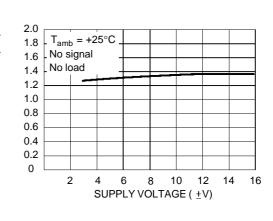
### TOTAL POWER DISSIPATION VERSUS FREE AIR TEMPERATURE



# SUPPLY CURRENT PER AMPLIFIER VERSUS FREE AIR TEMPERATURE



## SUPPLY CURRENT PER AMPLIFIER VERSUS SUPPLY VOLTAGE



081-16.EPS

081-14.EPS

SUPPLY CURRENT (mA)

081-11.EPS

COMMON MODE MODE REJECTION

OUTPUT VOLTAGE (mV)

#### **COMMON MODE REJECTION RATIO VOLTAGE FOLLOWER LARGE SIGNAL VERSUS FREE AIR TEMPERATURE PULSE RESPONSE** 89 INPUT AND OUTPUT VOLTAGES (V) 6 $R_L = 10 \text{ k}\Omega$ 88 4 $V_{cc} = \pm 15V$ INPUT 2 87 0 86 $V_{CC} = \pm 15V$ -2 85 $R_L = 2 k\Omega$ $C_L = 100pF$ -4 84 $T_{amb} = +25 \text{ C}$ -6 83 0.5 1.5 -75 -50 -25 25 50 100 125 0 75 TIME (µs) TEMPERATURE (°C) 081-17.EPS **OUTPUT VOLTAGE VERSUS EQUIVALENT INPUT NOISE VOLTAGE ELAPSED TIME VERSUS FREQUENCY** 28 70 24 V<sub>CC</sub> = ±15V OVERSHOOT 60 A <sub>V</sub> = 10 20 EQUIVALENT INPUT NOISE 50 $R_S = 100 \Omega$ VOLTAGE (nV/VHz) 16 = +25°C 40 12 30 8 $V_{CC} = \pm 15V$ 20 $R_L = 2k\Omega$ mamb # +25°C ų, 0.5 0.6 0.7 10 40k 100k 0.2 0.3 40 100 400 1k 4k 10k FREQUENCY (Hz) TIME (μs 081-19.EPS Td L HARMONIC DISTORTION VERSUS **FREQUENCY** V ½ <sub>© C</sub>= = 15/8√ A<sub>X</sub>(√= ± 1 TOTAL HARMONIC DISTORTION 0.4

0.1

0.04

0.01 0.004 0.001

%)

T<sub>malanb</sub>=±24525℃C

081-18.EPS

081-20.EPS

### PARAMETER MEASUREMENT INFORMATION

Figure 1: Voltage Follower

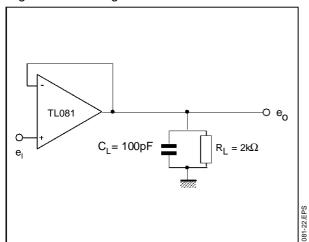
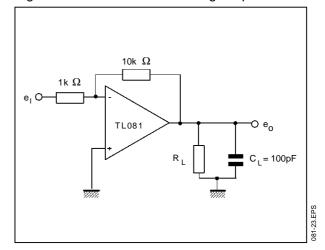
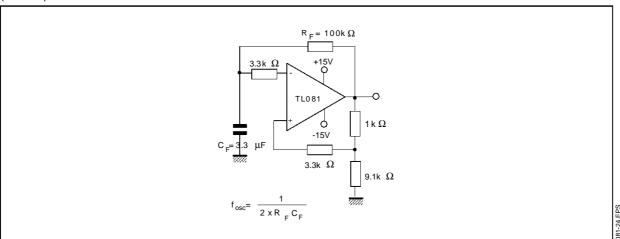


Figure 2: Gain-of-10 Inverting Amplifier

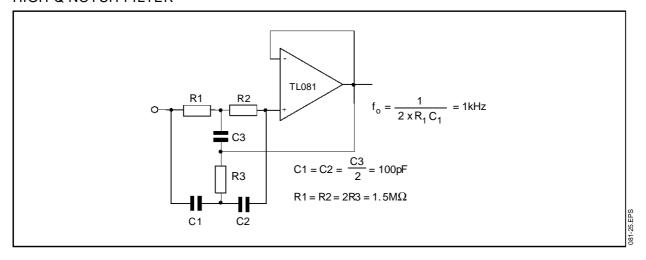


### **TYPICAL APPLICATIONS**

### (0.5Hz) SQUARE WAVE OSCILLATOR

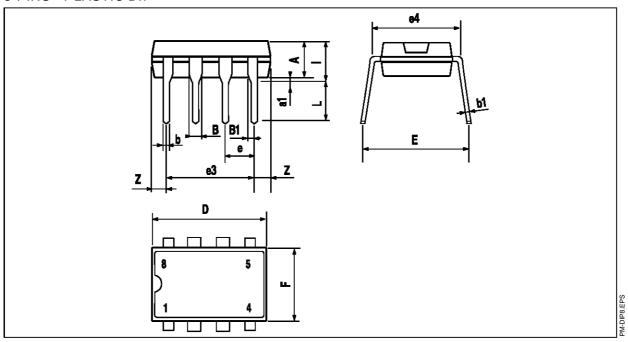


### HIGH Q NOTCH FILTER



### **PACKAGE MECHANICAL DATA**

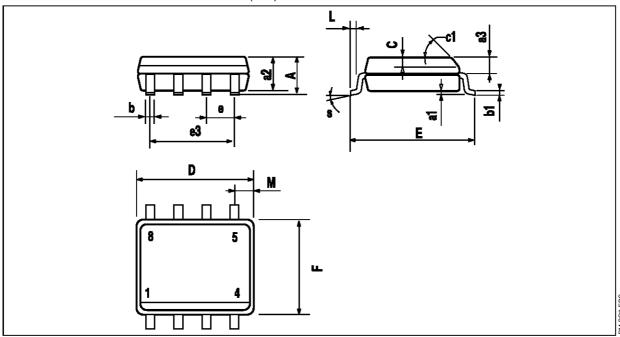
8 PINS - PLASTIC DIP



Dimensions	Millimeters			Inches				
Dimensions	Min.	Тур.	Max.	Min.	Тур.	Max.		
А		3.32			0.131			
a1	0.51			0.020				
В	1.15		1.65	0.045		0.065		
b	0.356		0.55	0.014		0.022		
b1	0.204		0.304	0.008		0.012		
D			10.92			0.430		
Е	7.95		9.75	0.313		0.384		
е		2.54			0.100			
e3		7.62			0.300			
e4		7.62			0.300			
F			6.6			0260		
i			5.08			0.200		
L	3.18		3.81	0.125		0.150		
Z			1.52			0.060		

#### PACKAGE MECHANICAL DATA

8 PINS - PLASTIC MICROPACKAGE (SO)



Dimensions	Millimeters			Inches			
	Min.	Тур.	Max.	Min.	Тур.	Max.	
А			1.75			0.069	
a1	0.1		0.25	0.004		0.010	
a2			1.65			0.065	
a3	0.65		0.85	0.026		0.033	
b	0.35		0.48	0.014		0.019	
b1	0.19		0.25	0.007		0.010	
С	0.25		0.5	0.010		0.020	
c1			45°	(typ.)			
D	4.8		5.0	0.189		0.197	
E	5.8		6.2	0.228		0.244	
е		1.27			0.050		
e3		3.81			0.150		
F	3.8		4.0	0.150		0.157	
L	0.4		1.27	0.016		0.050	
М			0.6			0.024	
S	8° (max.)						

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